

IN THE CLAIMS:

1 1. (CURRENTLY AMENDED) A method for ~~programming~~operating a pattern matching
2 engine having a plurality of information storage entries with ~~one~~two or more regular ex-
3 pressions, each regular expression including a plurality of characters and each regular
4 expression ~~defining~~associated with a corresponding action to be applied when matching
5 strings are found, the method comprising the steps of:

6 identifying one or more borders within a each regular expression, the one or more
7 borders separating the regular expression into a plurality of sub-expressions, ~~at least one~~
8 each sub-expression having a plurality of sequential characters; ~~and~~

9 loading ~~one or more~~each of a plurality of entries of the pattern matching engine
10 with a the plurality of the sequential characters from ~~more than one of the~~ sub-
11 expressions, wherein the borders are defined by a predetermined sequence of regular ex-
12 pression metacharacters, and the entries stored in content addressable memory (CAM)
13 and;

14 determining ~~if in parallel that the plurality of sequential characters from more than~~
15 ~~one~~ sub-expressions of each regular expression matches a string within a network mes-
16 sage; ~~and if so, then~~

17 executing the corresponding actions associated with that matched string the regu-
18 lar expressions on the network message.

1 2. (CURRENTLY AMENDED) The method of claim 1 wherein the predetermined se-
2 quence of regular expression metacharacters is a first regular expression metacharacter
3 defined to match any one character of the plurality of sequential characters from one of
4 the sub-expressions followed immediately by a second regular expression metacharacter
5 defined to match the one character zero, one, or more times.

1 3. (PREVIOUSLY PRESENTED) The method of claim 1 further comprising a step of
2 organizing at least part of the pattern matching engine into a plurality of sections, and
3 wherein each section of the pattern matching engine is loaded with a plurality of search
4 patterns for a corresponding sub-expression.

1 4. (CURRENTLY AMENDED) The method of claim 3 wherein the plurality of search
2 patterns ~~entries~~ of a section are loaded with a search pattern that includes a complete
3 match of a respective sub-expression, a search pattern that includes a partial match of a
4 the respective sub-expression, and a mismatch pattern.

1 5. (PREVIOUSLY PRESENTED) The method of claim 4 further comprising the steps
2 of:
3 associating at least one sub-expression with a current state variable; and
4 loading the associated current state variable into each entry of a section of the pat-
5 tern matching engine that contains the at least one sub-expression.

1 6. (CURRENTLY AMENDED) The method of claim 5 wherein the pattern matching
2 engine has at least one content addressable memory (CAM) loaded with the ~~one~~ two or
3 more regular expressions.

1 7. (PREVIOUSLY PRESENTED) The method of claim 6 wherein
2 the CAM is a ternary content addressable memory, a TCAM, that supports don't
3 care values, and
4 each regular expressions loaded to the CAM has a plurality of search patterns in-
5 cluding a mismatch pattern having don't care values.

1 8. (CANCELLED)

1 | 9. (CURRENTLY AMENDED) The method of claim ~~8~~7 wherein each entry of the
2 | TCAM identifies a corresponding entry of the second memory device.

1 | 10. (PREVIOUSLY PRESENTED) The method of claim 9 wherein at least one TCAM
2 | entry is associated with a next state variable, the method further comprising the step of
3 | loading an entry of the second memory device that is identified by the at least one
4 | TCAM entry with the associated next state variable.

1 | 11. (PREVIOUSLY PRESENTED) The method of claim 10 wherein
2 | the at least one TCAM entry is located in a TCAM section whose entries are as-
3 | sociated with a current state variable having a first value, and
4 | the next state variable has a second value that differs from the first value, wherein
5 | the next state variable specifies a new TCAM section to be searched.

1 | 12. (ORIGINAL) The method of claim 11 wherein each TCAM entry has a match cell
2 | that contains the complete match, the partial match or the mismatch pattern.

1 | 13 – 20. (CANCELLED)

1 | 21. (CURRENTLY AMENDED) The method of claim 1 wherein
2 | ~~each regular expression is associated with an action;~~
3 | the pattern matching engine further includes a second memory device having a
4 | plurality of entries, and
5 | the entries of the second memory device are loaded with the corresponding ac-
6 | tions associated with the ~~one~~two or more regular expressions.

1 | 22. (CURRENTLY AMENDED) A method for ~~programming~~operating a pattern match-
2 | ing engine having a plurality of information storage entries with ~~one~~two or more regular
3 | expressions, each regular expression including a plurality of characters and each regular

4 | expression ~~defining~~ associated with a corresponding action to be applied when matching
5 | strings are found, the method comprising the steps of:

6 | including at the pattern matching engine at least one ternary content addressable
7 | memory (TCAM) that supports don't care values, the at least one TCAM loaded with the
8 | ~~one two~~ or more regular expressions in TCAM entries; ~~and~~

1 | including a second memory device having a plurality of entries for loading actions
2 | corresponding to the ~~one two~~ or more regular expressions wherein each TCAM entry of
3 | the at least one TCAM identifies a corresponding entry of the second memory device;

4 | determining in parallel that the ~~plurality of sequential characters from more than~~
5 | ~~one~~ sub-expressions of each regular expression matches a string within a network mes-
6 | sage; and

7 | executing the corresponding actions associated with the regular expressions on the
8 | network message ~~that matched string~~.

1 | 23. (PREVIOUSLY PRESENTED) The method of claim 22 wherein at least one TCAM
2 | entry is associated with a next state variable, the method further comprising the step of
3 | loading the entry of the second memory device that is identified by the at least one
4 | TCAM entry with the associated next state variable.

1 | 24. (PREVIOUSLY PRESENTED) The method of claim 23 wherein
2 | the at least one TCAM entry is located in a TCAM section whose entries are as-
3 | sociated with a current state variable having a first value, and
4 | the next state variable has a second value that differs from the first value, thereby
5 | specifying a new TCAM section to be searched.

1 25. (PREVIOUSLY PRESENTED) The method of claim 24 wherein each TCAM entry
2 has a match cell that contains the complete match, the partial match or the mismatch pat-
3 tern.

1 26. (CURRENTLY AMENDED) An apparatus comprising:

2 means for ~~programming a~~ pattern matching ~~engine~~ having a plurality of informa-
3 tion storage entries with ~~one~~ two or more regular expressions, each regular expression
4 including a plurality of characters and each regular expression ~~defining~~ associated with a
5 corresponding action to be applied when matching strings are found;

6 means for identifying one or more borders within ~~a~~ each regular expression, the
7 one or more borders separating the ~~given~~ regular expression into a plurality of sub-
8 expressions, ~~at least one~~ each sub-expression having a plurality of sequential characters;
9 and

10 means for loading ~~one or more~~ each of a plurality of entries of the means for pat-
11 tern matching engine with a the plurality of the sequential characters from ~~more than one~~
12 the sub-expressions, the entries stored in content addressable memory (CAM);;

13 means for determining ~~if in parallel that the plurality of sequential characters from~~
14 ~~more than one sub-expressions of each regular expression~~ matches a string within a net-
15 work message;; and if so, then

16 means for executing the corresponding action associated with ~~that matched string~~
17 the regular expressions on the network message.

1 27. (PREVIOUSLY PRESENTED) The apparatus of claim 26, further comprising:

2 means for organizing at least part of the CAM into a plurality of sections, and
3 wherein each section of the CAM is loaded with a plurality of search patterns for a corre-
4 sponding sub-expression.

1 28. (PREVIOUSLY PRESENTED) The apparatus of claim 26, further comprising:

2 means for associating at least one sub-expression with a current state variable; and
3 means for loading the associated current state variable into each entry of the CAM
4 that contains the at least one sub-expression.

1 29. (CURRENTLY AMENDED) The apparatus of claim 26, further comprising:

2 ~~means for associating each regular expression with an action;~~
3 means for including at the pattern matching engine a memory device having a
4 plurality of entries;
5 means for loading the memory device with the corresponding actions associated
6 with the ~~one~~two or more regular expressions.

1 30. (PREVIOUSLY PRESENTED) The apparatus of claim 26 , further comprising:

2 means for using a ternary content addressable memory (TCAM) for the CAM,
3 each entry of the TCAM identifying a corresponding entry of the memory device.

1 31. (CURRENTLY AMENDED) An apparatus comprising:

2 a pattern matching engine having a plurality of information storage entries con-
3 figured to ~~program one~~ store two or more regular expressions, each regular expression
4 including a plurality of characters and ~~having associated with~~ a corresponding action to
5 ~~be applied to matching strings a network message;~~ the pattern matching engine config-
6 ured to identify one or more borders within a ~~given~~-regular expression, the one or more
7 borders separating the ~~given~~-regular expression into a plurality of sub-expressions, ~~at~~
8 ~~least one~~ each sub-expression having a plurality of sequential characters; the pattern
9 matching engine configured to determine in parallel that the plurality of sequential char-
10 acters from ~~more than one~~ the sub-expressions of each regular expression matches a
11 string within the network message, and ~~if there is a matched string,~~ then to execute the

12 | corresponding actions associated with ~~that matched string~~, the regular expression on the
13 | network message; and

14 | a content addressable memory (CAM), the CAM configured to store ~~a~~the plural-
15 | ity of ~~the~~ sequential characters from the plurality of at least one sub-expressions.

1 | 32. (PREVIOUSLY PRESENTED) The apparatus of claim 31, further comprising:

2 | at least part of the CAM organized into a plurality of sections wherein each sec-
3 | tion is loaded with a plurality of search patterns for a corresponding sub-expression.

1 | 33. (CURRENTLY AMENDED) The apparatus of claim 31, further comprising:

2 | the pattern matching engine configured to associate each ~~at least one~~ sub-
3 | expression with a current state variable; and

4 | the pattern matching engine configured to store ~~the~~ each associated current state
5 | variable into ~~each~~ a CAM entry that contains ~~the~~ at least one sub-expression.

1 | 34. (CURRENTLY AMENDED) The apparatus of claim 31, further comprising:

2 | a second memory device having a plurality of entries; ~~the~~ second memory device
3 | configured to store the corresponding actions associated with the ~~one~~ two or more regular
4 | expressions.

1 | 35. (CURRENTLY AMENDED) The apparatus of claim 31, further comprising:

2 | the CAM configured as a ternary content addressable memory (TCAM), the
3 | TCAM storing a corresponding entry for each entry of the second memory device.

1 | 36. (New) A method for operating a pattern matching engine comprising the steps of:

2 obtaining two or more regular expressions;
3 identifying one or more borders within each regular expression using a determi-
4 nistic finite state machine, the one or more borders separating the regular expression into
5 a plurality of sub expressions, each sub expression including one or more characters, each
6 border indicated by one or more predetermined metacharacters;
7 loading separate portions of a memory of the pattern matching engine with the
8 sequential characters from each of the plurality of sub expressions of the two or more
9 regular expressions;
10 applying a string from a network message to the memory to search the string in
11 parallel for sub expressions from each of the two or more regular expression;
12 determining that at least one of the two or more regular expressions matches the
13 string and executing in response thereto a corresponding action associated with that regu-
14 lar expression.

1 37. (NEW) The method of claim 36 wherein the memory is a content addressable mem-
2 ory (CAM).

1 38. (NEW) The method of claim 36 wherein the step of loading further comprises the
2 step of:
3 generating a plurality of search patterns for the sequential characters from each of
4 the plurality of sub expressions and loading these search patterns into the the seperate
5 portions of the memory.

1 39. (New) An apparatus comprising:
2 a pattern matching engine configured to obtain two or more regular expressions
3 and to identify one or more borders within each regular expression using a deterministic
4 finite state machine, the one or more borders separating the regular expression into a plu-

5 rality of sub expressions, each sub expression including one or more characters, each
6 border indicated by one or more predetermined metacharacters;
7 a memory of the pattern matching engine configured to store the sequential charac-
8 ters from each of the plurality of sub expressions of the two or more regular expressions
9 in separate portions of memory, the memory further configured to, in response to applica-
10 tion of a string from a network message, search the string in parallel for sub expressions
11 from each of the two or more regular expression, and to determine that at least one of the
12 two or more regular expressions matches the string; and
13 the pattern matching engine further configured to cause the execution of a corre-
14 sponding action associated with that regular expression that matches.

1 40. (NEW) The apparatus of claim 39 wherein the memory is a content addressable
2 memory (CAM).

1 41. (NEW) The apparatus of claim 39 wherein the memory is further configured to store
2 a plurality of search patterns for the sequential characters of each of the plurality of sub
3 expressions.